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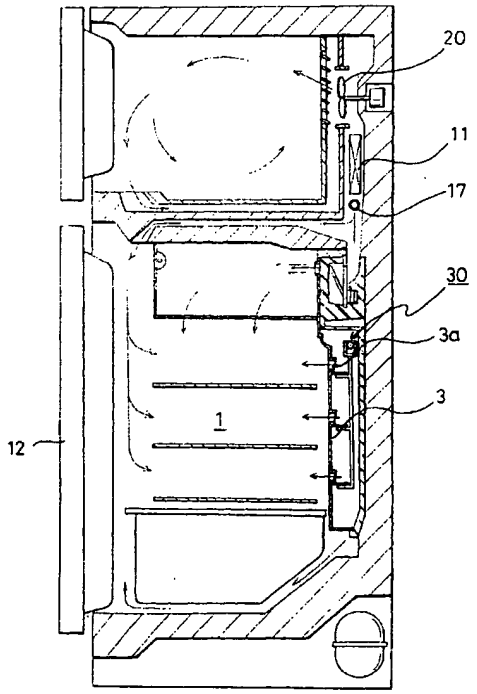
(54) Refrigerator

(57) A refrigerator has openings (3a) between an air duct (2) and a fresh food compartment (1). Flaps (32; 52) are provided for opening and closing the openings (3a) during defrosting or when the fresh food compartment (1) is opened. The flaps (32; 52) are moved between open and closed positions by means of a motor (40; 60), a pair of opposed racks (35) and a sector gear (38; 58). The racks (35) and the sector gear (38; 58) are arranged such the motor (40; 60) turns in the same direction for both opening and closing the openings (3a).

FIG. 2



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Description

The present invention relates to a refrigerator comprising an evaporator, a cooling air duct for guiding cooling air from the evaporator, the duct having an opening in a wall thereof into a fresh food compartment.

Referring to Figure 1, a prior art refrigerator has a body 14 defining a freezing compartment 15 and a fresh food compartment 1, first and second doors 16, 12 for opening/closing the freezing compartment 15 and the fresh food compartment 1 respectively, a compressor 19 for compressing refrigerant, an evaporator 11 for generating cool air by evaporating refrigerant supplied from the compressor 19, and a fan 20 for blowing the cool air generated by the evaporator 11.

A duct member 3 forming a cool air duct 2 is installed at the back of the fresh food compartment 1. The duct member 3 has a plurality of cool air discharge ports 3a opening into the fresh food compartment 1. Cool air blown by the fan 20 flows into the cool air duct 2, and is then discharged into the fresh food compartment 1 through the cool air discharge ports 3a. A guide device 13 for guiding the cool air flowing in the cool air duct 2 toward the cool air discharge ports 3a is installed in the cool air duct 2.

While the refrigerator is operating, frost forms on the evaporator 11, lowering the cooling efficiency of the refrigerator. To overcome this, the refrigerator is equipped with a heater 17 for removing the frost, and periodically performs a defrosting operation involving heating the evaporator 11 using the heater 17.

In such a refrigerator, the heat generated by the heater 17 during the defrosting operation is transmitted into the fresh food compartment 1. The heat generated by the heater 17 is mainly transmitted through the cool air path. That is, the heat is mainly transmitted to the fresh food compartment 1 through the cool air duct 2 and the cool air discharge ports 3a. The cooling efficiency of the fresh food compartment 1 is lowered due to the heat transmitted to the fresh food compartment 1 and the food stored therein can spoil.

Furthermore, when a user opens the second door 12, the warm ambient air flows into the fresh food compartment 1, mainly flows into the area adjacent to the evaporator 11. When the ambient air flows toward the evaporator 11, the rate at which frost forms on the evaporator 11 increases. This means that the defrosting operation must be performed more frequently. The heater 17 must be operated in order to perform the defrosting operation, so the cooling efficiency is lowered further because of the necessity for the frequent defrosting.

A refrigerator according to the present invention is characterised by a flap for blocking and unblocking the opening and actuator means for moving the flap between opening-blocking and opening-unblocking positions, the actuator means comprising a motor and a transmission configured such that moving the flap from the opening-blocking position to opening-unblocking positions and vice versa are effected by running the motor in the same direction.

Preferably, defrosting control means, operable to periodically energise a heater for defrosting the evaporator and operate the actuator means so as move the flap into the opening-blocking position when the heater is energised, is provided.

Preferably, a fresh food compartment door, a door open sensor for sensing opening of the fresh food compartment door and anti-frosting control means, responsive to the door open sensor to operate the actuator means so as move the flap into the opening-blocking position when the fresh food compartment door is opened, are provided.

Preferably, there is a plurality of openings in said wall into the fresh food compartment and a respective flap is provided for blocking each of the openings (3a).

Preferably, the actuator means comprises an actuator member drivingly engaging the or each flap, a pair of opposed racks mounted to the actuator member, and a sector gear drivingly coupled to the motor and located for selectively engaging the racks in dependence on its angular position.

The actuator member may comprise a respective finger for supporting and pivoting the or each flap. Alternatively, the or each flap may include a finger projecting parallel to its axis of rotation into a respective hole in the actuator member.

Embodiments of the present invention will now be described, by way of example, with reference to Figures 2 to 6 of the accompanying drawings, in which:-

Figure 1 is a side sectional view of a prior art refrigerator;
Figure 2 is a side sectional view of a refrigerator according to the present invention;
Figure 3 is an enlarged perspective view of an opening/closing device shown in Figure 2;
Figure 4 is a side sectional view of Figure 3;
Figure 5 is another embodiment of the opening/closing device according to the present invention; and
Figure 6 is a side sectional view of Figure 5.

Parts common the refrigerators described below and the above-described refrigerator will not be described again. However, the same reference numbers will be used.

Referring to Figures 2, 3 and 4, an opening/closing device 30 for opening/closing the cool air discharge ports 3a is installed in the cool air duct 2.

The opening/closing device 30 includes a driving motor 40 installed in the cool air duct 2, a driving member 38 drivingly coupled to the driving motor 40, an operation member 36 operated by the driving member 38, and a plurality of plates 32, each operated by the operation member 36.

Brackets 42 are formed at both ends of the lower

edge of each cool air discharge port 3a, and hinge pins 41 extend between and are supported by pairs of the brackets 42. A respective plate 32 is hingedly mounted along the bottom of each of the cool air discharge ports 3a by respective hinges pin 41. The plates 32 pivot between the cool air discharge port blocking and unblocking positions.

The operation member 36 has a pair of racks 36a, 36b, disposed parallel to each other. Each of the racks 36a, 36b has teeth 35 facing to each other. The operation member 36 also has an actuator rod 36c extending downwardly therefrom.

Fingers 36d protrude perpendicularly from the actuator rod 36c. The fingers 36d support the plates 32. The plates 32 are supported by the fingers 36d so that the cool air discharge ports 3a are opened when the actuator rod 36c is moved down as shown in Figure 3, and the cool air discharge ports 3a are closed when the actuator rod 36c is moved up as shown in Figure 4.

The driving member 38 is connected to the rotational shaft 39 of the driving motor 40. Teeth 37 are formed on part of the periphery of the driving member 38. The teeth 37 are formed over less than half of the periphery of the driving member 38. The driving member 38 is disposed between the racks 36a, 36b, and the teeth 37 of the driving member 38 engage the teeth 35 of the racks 36a, 36b. In this situation, since the teeth 37 of the driving member 38 are formed over less than half of the periphery of the driving member 38, the driving member 38 selectively engages one or other of the racks 36a, 36b.

While the refrigerator is operating, the driving motor 40 is driven by a control part (not shown) to rotate the driving member 38 in an anticlockwise direction. In this case, the drive from the driving motor 38 is applied to the left rack 36b and the operation member 36 is moved down. When the operation member 36 is moved down, the plates 32 which have been supported by the supporting protrusions 36d pivot downwards and the cool air discharge ports 3a are opened as shown in Figure 3.

When the defrosting operation of the refrigerator begins, the driving motor 40 rotates the driving member 38 in an anticlockwise direction again. In this case, the drive from the driving member 38 is applied to the right rack 36a and the operation member 36 is moved up. When the operation member 36 is moved up, the plates 32 pivot upwards and the cool air discharge ports 3a are closed as shown in Figure 4.

During the operation of the refrigerator, when a user opens the second door 12, the opening of second door 12 is sensed by a sensor for use in sensing the opening/closing of the second door 12, and then the control part drives the driving motor 40 to close the cool air discharge ports 3a as described above.

Since the cool air discharge ports 3a are closed during defrosting when the heater 17 is generating heat and/or when the second door 12 is open, the transmission of the heat from the heater 17 to the fresh food compartment 1 and the transmission of warm ambient air to the evaporator 11 are prevented. Therefore, the lowering of the cooling efficiency of the fresh food compartment 1 is prevented and the frost does not form on the evaporator 11 as a result of ambient air entering the refrigerator.

It should be noted that both opening and closing of the cool air discharge ports 3a is effected by the rotation of the driving member 38 in the same direction. In other words, when the driving member 38 is rotated by the driving motor 40, the operation member 36 is moved up and down repeatedly. Therefore, there is an additional advantage that the opening and closing operations of the plates 32 can be controlled by a motor capable of rotating in only one direction.

Referring to Figures 5 and 6, the construction and the operation of the driving motor 60, driving member 58, and the operating member 56 are the same with those of the embodiment shown in Figures 2 through 4.

The plates 52 are fixed by pivot pins 52a. The plates 52 open and close the cool air discharge ports 3a according to their positions. A respective pin 61 projects from a corner of each plate 52. The pins 61 project into holes in the actuator rod 56c of the operation member 56. When the driving motor 60 operates to move the operation member 56 up, the plates 52 pivot as shown in Figure 6, and thereby the cool air discharge ports 3a are closed. When the operation member 56 moves down, the plates 52 pivot as shown in Figure 5, and thereby the cool air discharge ports 3a are opened.

The operation of the refrigerator having the opening/closing device according to the present embodiment is similar to that of the embodiment shown in Figures 2 through 4. That is, when the second door 12 is opened or the defrosting operation of the evaporator 11 is performed by the heater 17, the driving motor 60 is driven by the control part (not shown) so that the cool air discharge ports 3a are closed by the plates 52.

As described above, according to the present invention, since the heat exchange between the evaporator and warm ambient air is prevented during defrosting and when the door is open, the cooling efficiency is enhanced and frost does not form on the evaporator 11 when the second door is opened.

Claims

1. A refrigerator comprising an evaporator (11), a cooling air duct (2) for guiding cooling air from the evaporator (11), the duct (2) having an opening (3a) in a wall (3) thereof into a fresh food compartment (1), **characterised by** a flap (32; 52) for blocking and unblocking the opening (3a) and actuator means (30; 50) for moving the flap (32; 52) between opening-blocking and opening-unblocking positions, the actuator means (30; 50) comprising a motor (40; 60) and a transmission (35, 38; 56, 58) configured such

that moving the flap (32; 52) from the opening-blocking position to opening-unblocking positions and vice versa are effected by running the motor (40; 60) in the same direction.

2. A refrigerator according to claim 1, including defrosting control means operable to periodically energise a heater (17) for defrosting the evaporator (11) and operate the actuator means (30; 50) so as move the flap into the opening-blocking position when the heater (17) is energised.

3. A refrigerator according to claim 1 or 2, including a fresh food compartment door (12), a door open sensor for sensing opening of the fresh food compartment door (12) and anti-frosting control means responsive to the door open sensor to operate the actuator means (30; 50) so as move the flap into the opening-blocking position when the fresh food compartment door (12) is opened.

4. A refrigerator according to claim 1, 2 or 3, wherein there is a plurality of openings (3a) in said wall (3) into the fresh food compartment (1) and a flap (32; 52) is provided for blocking each of the openings (3a).

5. A refrigerator according to any preceding claim, wherein the actuator means (30; 50) comprises an actuator member (36c, 36d; 56c) drivingly engaging the or each flap (32; 52), a pair of opposed racks (35; 56) mounted to the actuator member (36c, 36d; 56c), and a sector gear (38; 58) drivingly coupled to the motor (40; 60) and located for selectively engaging the racks (35; 56) in dependence on its angular position.

6. A refrigerator according to claim 5, wherein the actuator member (36c, 36d) comprises a respective finger (36d) for supporting and pivoting the or each flap (32).

7. A refrigerator according to claim 5, wherein the or each flap (52) includes a finger (61) projecting parallel to its axis of rotation into a respective hole in the actuator member (56c).

8. A refrigerator comprising:

a door for opening/closing a cooling compartment;
an evaporator for generating cool air to be supplied into said cooling compartment by evaporating refrigerant;
a heater for removing frost generated on said evaporator;
a duct member forming a cool air duct for guiding the cool air generated from said evaporator, said duct member being formed with a plurality of cool air discharge ports opened in said cooling compartment;
an operation member having a pair of racks disposed in parallel with each other, said racks being formed with gear parts respectively at sides facing to each other;
plates being installed at areas adjacent to the cool air discharge ports respectively, said plates pivoting by the movement of said operation member, said plates for opening/closing the cool air discharge ports according to a pivoting position;
a driving member being disposed between said racks, said driving member being formed with a gear part engaged selectively with the gear parts of said racks according to a rotated position thereof; and
a driving motor for rotating said driving member so that the cool air discharge ports are closed during a defrosting operation of said heater and/or when said door is open.

9. The refrigerator as claimed in claim 8, wherein said plate is hingedly mounted at an edge of the cool air discharge port.

10. The refrigerator as claimed in claim 9, further comprising support protrusions protruding at a part of said operation member, said support protrusions for supporting said plates so that said plates open the cool air discharge ports when said operation member is moved down, and said plates close the cool air discharge ports when said operation member is moved up.

11. The refrigerator as claimed in claim 8, wherein said plates are connected to said operation member to be capable of pivoting.

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FIG. 1

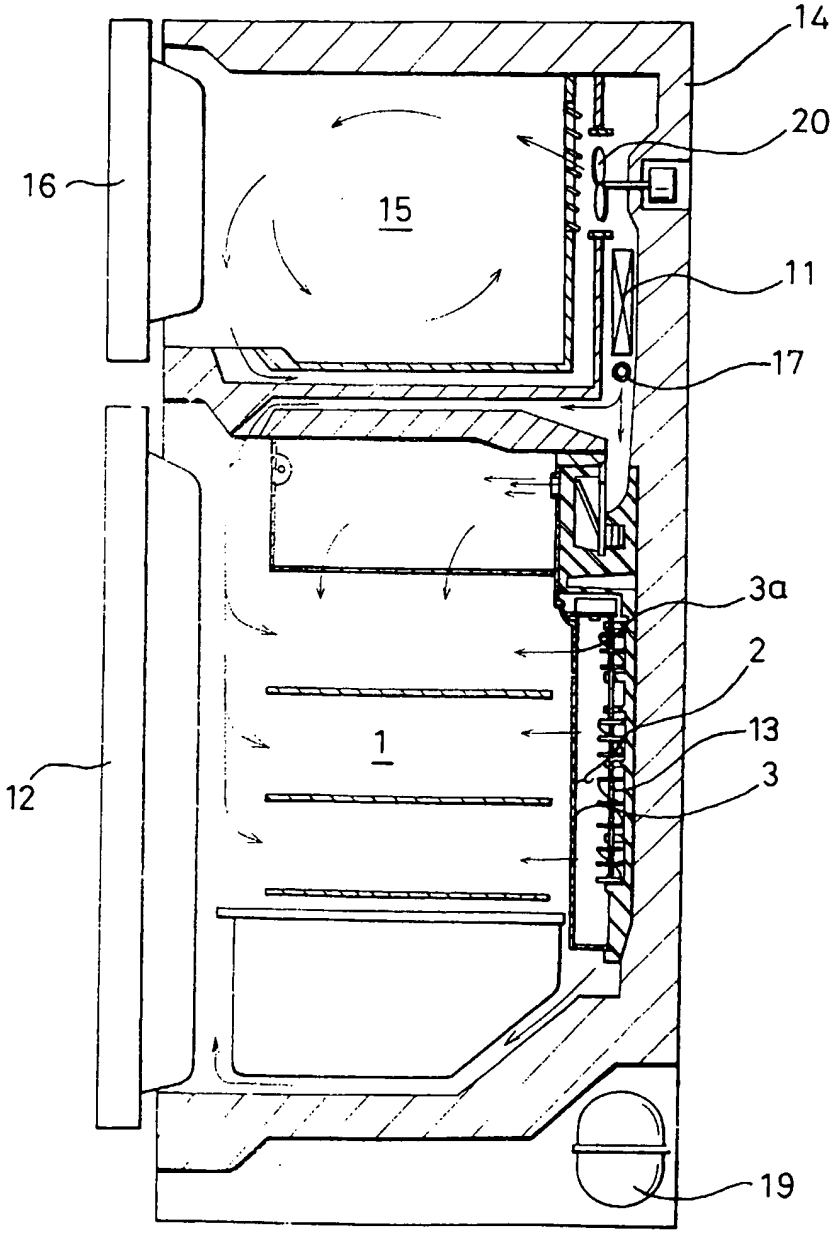

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FIG. 2

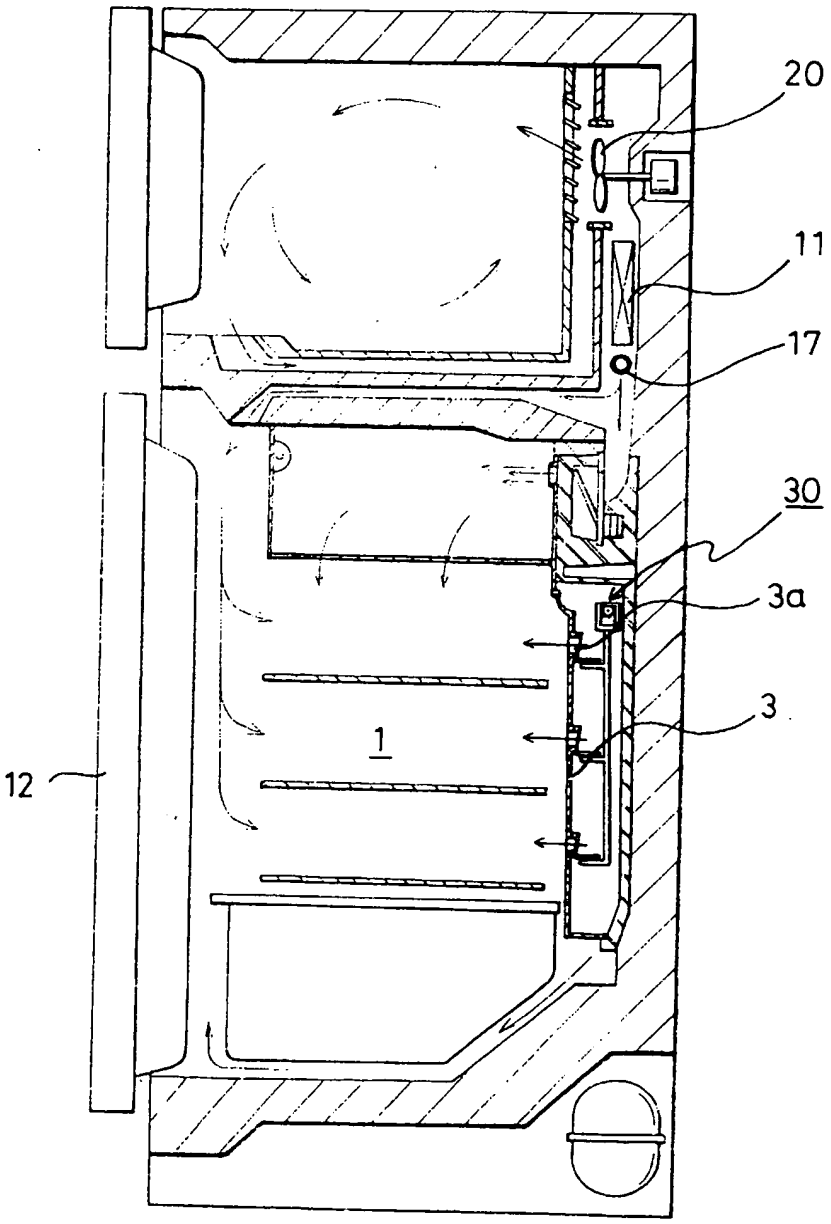

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FIG. 3

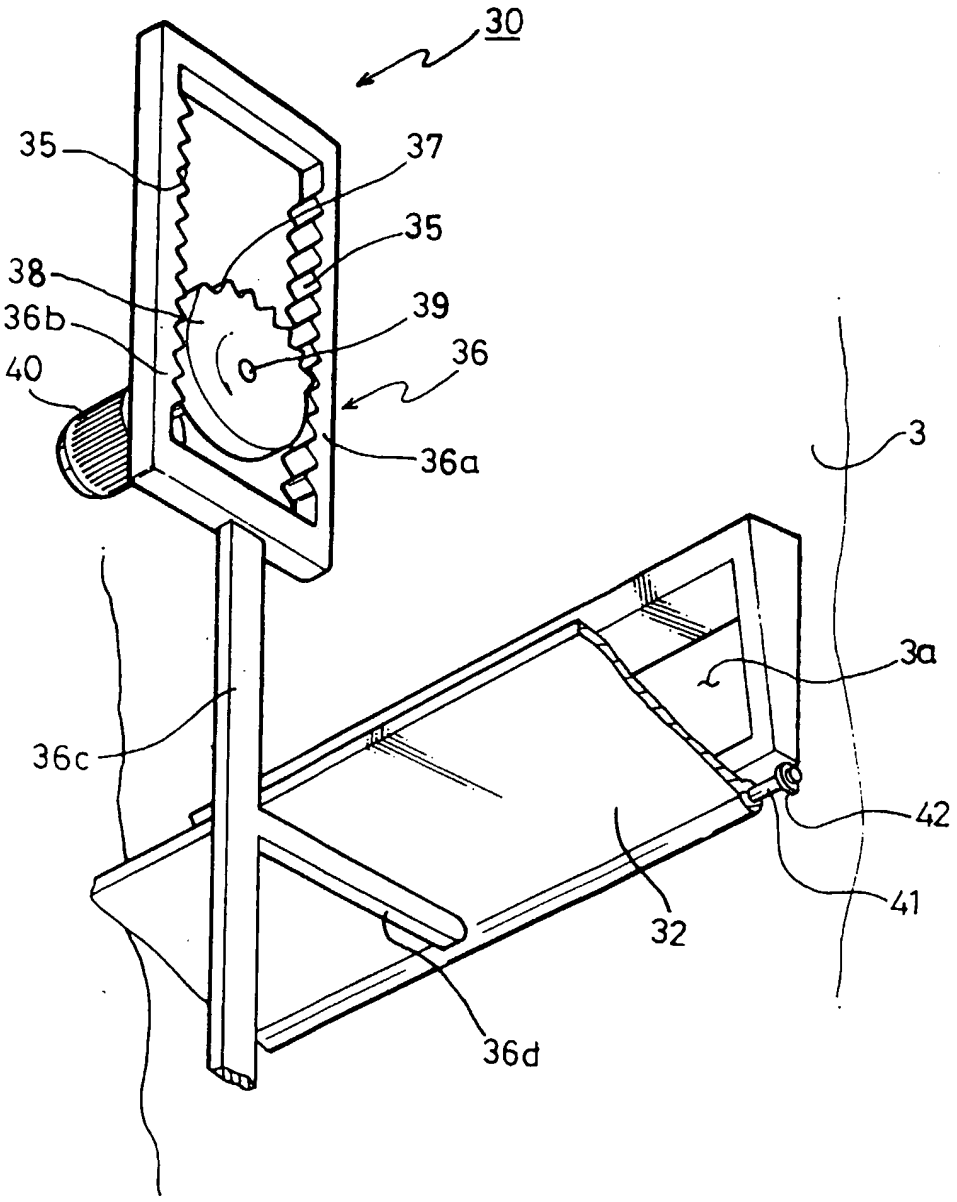

FIG. 4

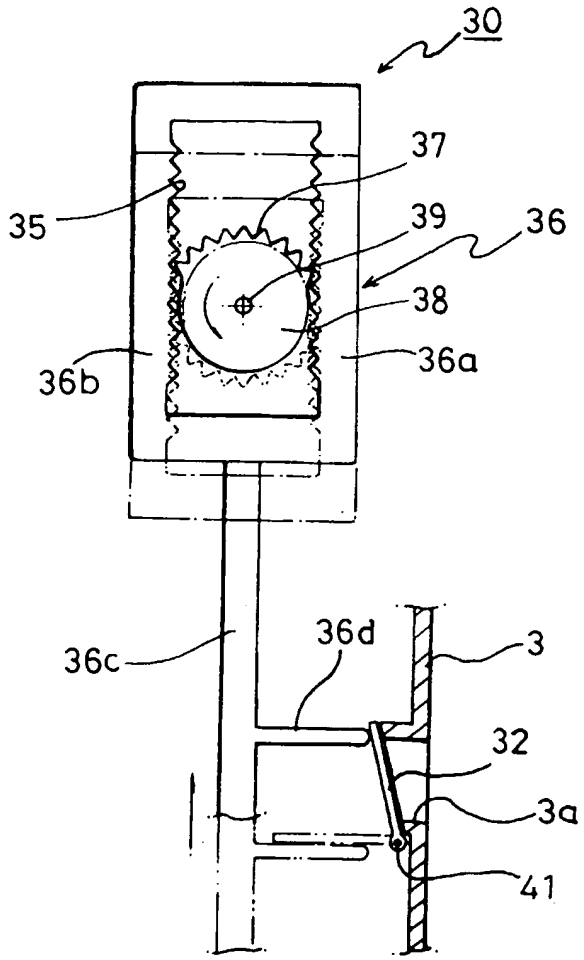

FIG. 5

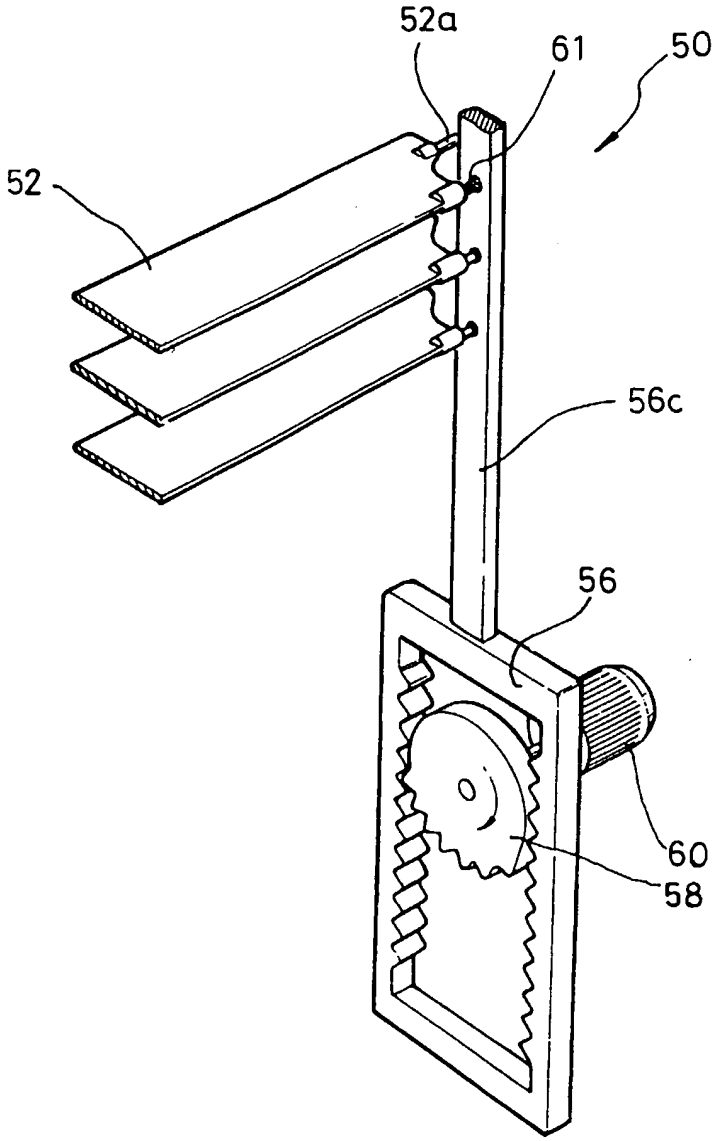

FIG. 6